Habitat Mapping, Geobotanical Classifications, and Geographic Information Systems

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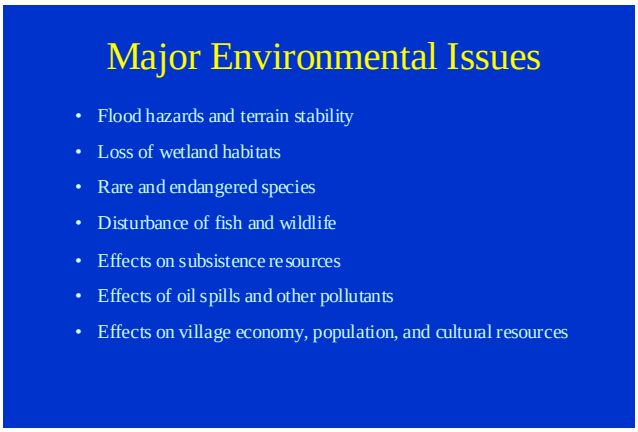
One of the advantages of going late on the program is that I can try to tie together some of the themes that we have been hearing for the last two days. For those of you who keep up with conservation biology and wildlife management, you've probably heard a lot of rhetoric in recent years about ecosystem management. At times it is presented as a novel concept, but if you have ever read "A Sand County Almanac", by Aldo Leopold , you know that this concept is well established well over a half a century ago. What is new, however, is that we now have tools available to us that allow us to integrate physical and biological ecosystem management information on multiple spatial scales, and to use the resulting information to make informed management decisions. So I think that ecosystem management has gone from a theoretical concept to a real practice, and there is perhaps no better example of this than the work that has recently been done in the Colville River Delta in support of the Alpine Development Project.

You have seen the Alpine project from a couple of different speakers here, but this slide shows the Colville Delta, which drains approximately 60 percent of the North Slope watershed. The picture shows the western edge of the Kuparuk oil field, and shows the Alpine pipeline, and the Alpine development area on the Delta, as well as what is referred to as the transportation corridor. The village of Nuiqsit is also shown. Keep in mind the shape of the yellow perimeter on this map, because it will be seen on some thematic maps of Alpine, so it will make more sense to you. Most of you know the story of the Alpine development. Following exploration, delineation, and testing in 1991 to 1995, ARCO and Anadarko decided to develop the Alpine oil field underlying the Colville River delta. Recognizing the ecological importance of the Delta, ARCO initiated studies in 1992 to provide baseline information for project planning and design. This has long been known to be an extremely productive area. As a basis for comparison, I think that most biologists familiar with the North Slope would say that the area is much more diverse and much more productive than the ANWR 1002 area. It is a really an important and unique habitat feature on the North Slope

There are large lakes and ponds throughout, there are river channels, and then there is extensive wetland areas that combine to be one of the most productive water bird areas that we know of in the Arctic. ARCO initiated its study in 1992 to provide baseline

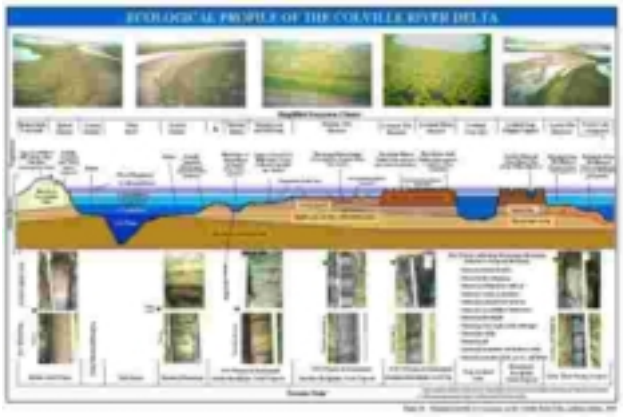


information for project planning and design. An important point here is that ARCO began extensive environmental studies at a regional scale five years prior to the decision to proceed with this development. In addition they consulted with resource agencies and the native community in Nuiqsut, prior to the implementation of wildlife studies to gain a clear understanding of what issues would be most prominent if and when they applied for permits to develop the field. In those early consultations, a number of prominent issues were identified. I think Mike Joyce of ARCO deserves a lot of credit here. He was very proactive in soliciting agency input and input from native stakeholders in the region to identify exactly to do to--using Commissioner Brown's terminology, "do it right."

Interestingly, along with some of resource agencies, we had just finished the Lisburne development monitoring studies a couple of years earlier, and one of the complaints about our program, which was a well funded and rigorous program, was that there was no predevelopment environmental baseline. So Mike went back to the same people to ask them what it would take to "do it right"? What did they want to see in terms of information if this area is going to be developed? So for Alpine, we had agency input into the design of the research, we had input from the village of Nuiqsut, and that has gone a long way toward determining just exactly what we were going to be doing on the Delta.

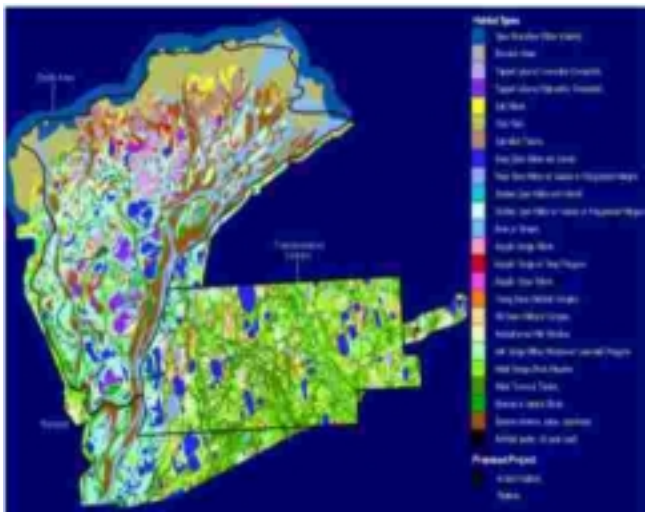
The Colville Delta long has been recognized as one of the most productive regions for fish and wildlife on the Arctic coast of Alaska. The area is important for breeding of tundra swans, brant, yellow billed loons, and greater white-fronted geese. Arctic cisco and broad whitefish overwinter on the Delta, and they support both the subsistence fishery and the only commercial fishery on the North Slope. Caribou from both the Central Arctic and the Teshepuk Lake herds use the Delta, and the area's fish and wildlife resources for the subsistence economy and culture of the local residents in and around the village of Nuiqsut.

So the challenge for us is to figure out exactly what we need to be doing in the field in our studies to answer the questions that come up and address the concerns. This is an overview of the studies that ABR and some of the other consultants have undertaken in the Delta. The area does drain some 60% of the North Slope watershed, so you can imagine what the floodwaters are like there during spring breakup. It is important to know from an engineering perspective whether areas where they might put facilities become flooded out. They also need to know the stability of the terrain. This is a dynamic environment with meandering river channels, and it is important to know whether the places you put pipelines, gravel pads and facilities are going to have erosion problems twenty years from now. And then, of course, there are all of the issues regarding fish and wildlife habitat that we had to pull together information for to address the topics of concern.



I'm going to start out with a fairly complicated slide. Across the top you see several of the different habitat types that we encounter on the Colville Delta. In the center, we see a profile of what the Delta would look like in cross section. And what we are trying to look at here is what is the depositional environment, what is the ice environment, and how does that effect the stability, how does it effect the surface forms, how does it effect vegetation, which really reflects what is happening with soils and with the land form. Vegetation is usually the key to how the wildlife are going to be using the area. Down on the bottom we have soil cores, and what we were looking for in these soil cores were some indication of the flooding activity and the depositional environment which helps us to predict where floods are going to occur. The top line is the 25 to 200 year flood level, then we have the five to 25 year flood, and the one to two year flood we have nearly every year. This is important information to understand just exactly what the dynamics of the hydrology of the Delta were, and how that effects all of the other physical and biological processes.

So what we did initially was to map out "terrain units". We had several different ways to classify the landscapes, and "terrain units was just one of them, which is basically what the depositional environment is. We also looked at the surface forms, which is a reflection primarily of ice processes, and then we also looked at vegetation itself. We had a number of vegetation classes identified – this figure doesn't reflect them all because the color contrast is not very good, but essentially we had 23 units, 16 land forms, and 18 vegetation types. With these various combinations, we wound up with 195 ecological land classes. We then recombined these land classes and analyzed a set of 24 wildlife habitats.



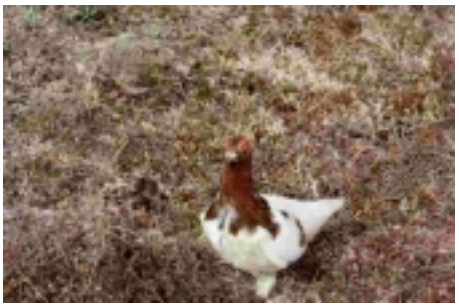
Ryan Lance showed this slide yesterday of the 24 wildlife habitats. The take home message here is that we have quite a mosaic of habitats, and you're going to see differential use of these habitats of wildlife. And that is what we are trying to do – identify and characterize the most important areas of this landscape for fish and wildlife.

After we have a map like that from our GIS database, it is very easy for us to calculate areas. And so here is a list of the 24 habitat types identified in the Delta transportation corridor, and the relative percentages of each of the 24 habitat types that occur in the delta. So we know instantly whether it is a rare habitat or it is a common habitat, and we combine this with the wildlife data. If you have a habitat that is used by a lot of species in high densities, and it is rare, then you know that you have a pretty valuable habitat. On the other hand, if you have a common habitat that isn't preferred by any birds and mammals, you know that you have something that is not as important in terms of project planning.

As I mentioned, the wildlife studies started in 1992, and we had five years of baseline going before the decision to develop was made, and we also have data for each one of the subsequent years, so we are up to about nine years of data to this point. Rick Johnson is going to go into more detail on the bird studies, but I will give you an overview of what some of the most important species are, and why we are studying them. The spectacled eider which is a protected under the Endangered Species Act, and which has received a lot of attention from resource agencies. It is critical for anybody developing anything on the North Slope to get site clearance to first find out if these birds are nesting there. Well, finding spectacled eider nests is not very easy because the female eider is not nearly as easy to see as the male eider. As a result, we spend a lot of time marching around the tundra trying to find these nests over broad areas. It is very labor intensive and very time consuming work.

Tundra swans as I mentioned use the Delta extensively. They are considered by a lot of people to be good indicators of the health of the environment. They are easy to survey by airplane because they are big and white, and so we have a big database on swans, and it is one we definitely want to get a baseline on to look at what happens to the population over time. It is also an important species for deciding facility siting.

There are also geese on the North Slope that are important for subsistence, and they are also protected under migratory waterfowl treaties, so they also receive a lot of attention from the resource agencies.



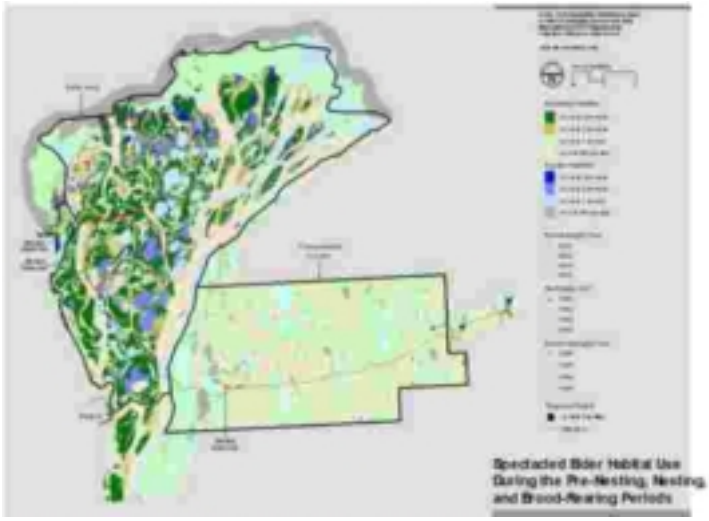
Then we have some of the more resident types of species, ptarmigans for example, is once again a subsistence species. It is important for us to look not only at the high profile birds that show up in the lower 48 during the winter, but to also look at some birds that are important to the local residents. We also looked at some birds that are not consumed by anyone – they are just part of the landscape - like golden plover. There is a lot of interest of protecting habitat for these migratory birds, and we looked at 50 species of birds and a suite of mammal species to figure out what is happening with each population prior to the development, which helps us assess how to proceed with development, and then how to look at post-development impacts.

Arctic foxes – we will hear about them in more detail from the next speakers, but they are important for us to keep track of. We've got a good running tally of where all their dens are, and it is important to know whether they increase as the result of the development. And of course caribou are really important. I won't go into a lot of detail about caribou, because the Colville Delta is not one of the hot spots for caribou. It is close to where they calve, but they generally do not calve on the Delta itself, although there is some calving activity in the transportation corridor.

So this is the list of species that we looked at, and when we get data, it is not only from ABR sightings, but it is also a lot of work from Fish and Game and the Fish and Wildlife Service for both polar gears and grizzly bears. So we have a pretty big area hear around the Delta where bear sightings and bear dens are being recorded. Interestingly, while most of the polar bear dens are near the coast, there are a couple of them that were actually in or close to the transportation corridors. That is important to know because they are protected under the Marine Mammals Protection Act, and its also good to like to know where they are when you are doing winter work out there. After we digitize all of this information, we use the habitat map in conjunction with the wildlife sightings to determine the most important habitat areas.

At this point, we again went back to the resource agencies with our database, and asked them what information was important for them to know about the Alpine development and its effects. We looked at the regional importance of five endangered or high profile species, overall diversity (i.e., which habitats are supporting the greatest number of birds and mammals?), and subsistence species (i.e., what habitats are used by species important for subsistence?). So, having 50 bird species and a dozen mammal species, there are a number of ways to look at the area.

Using spectacled eiders during pre-nesting as an example, there is just handful of habitat that they use. We've got the number of sitings by habitat, and we know the availability of each habitat type. We then performed a couple of different analyses to determine whether these birds are preferring, avoiding, or just using the habitat at a level that is equal to its availability. Monte Carlo simulations turned out to be the best way to get quantitative measures with a confidence interval to test the hypothesis of whether the habitat is preferred or avoided. We then used these results to construct a fairly simple map.



For this map, we combined the nesting, pre-nesting and brood rearing data, and we color coded the maps to show which areas were used during all three of these periods in both terrestrial habitat and aquatic habitat. So the dark green and the dark blue are the hot spots for the eiders.

So here is a simple thematic map that we can use for information transfer, because one of the elements of the NEPA process is that you are supposed to instill your information to a nonbiological audience – it has to be accessible to a to a nonbiological audience. So this is one of the ways we can pull this data into something that is fairly accessible. We can simply show them the map and say that these are the hot spots for spectacled eiders. And we can do the same thing, for the subsistence species, caribou, or whatever people want to look at we can take these data and produce these thematic maps. If we go back to Commissioner Brown's statements about sound science, prudent management and public input, I think this plays into all of these. There is sound science on the bottom of this – it provides some of the answers to the people making management decisions about what the effects of an action might be, and I think it is reasonably accessible, at least as compared with some of the stuff that the scientists produce that people without technical background can understand.

What we can do with out GIS system is to slice out the habitats that might be consumed either by being covered by gravel or as a buffer, and can calculate very precisely what habitats will be lost. And from that you can determine what effect the action will have on the species. For example, if you're particularly worried about threatened and endangered species, one route may be worse or better for spectacled eiders, for example.

This is also a way that we can communicate with the engineers, which is something that has been kind of elusive over the years. We have a common spatial database with the engineers. We are sharing their drawings. They have access to our hydrology maps, our terrain maps. And we have access these various alternatives. And these were changing almost on a weekly basis, and the beauty of having this in a GIS database is that we can just turn the crank and say "OK, well they moved it. Let's do the exercise again and figure out how much habitat is lost by that particular scenario". And that really helps us to make these impact predictions.

In summary, these baseline studies and the development of GIS database aid in the evaluation of land capabilities and potential project impacts. These evaluations result in thematic maps that facilitate communication among developers, agency personnel and the public. For environmental impact analysis, this spatially explicit ecological data in a GIS database provide a common means for evaluating a wide range of potential impacts associated with oil development, including precise measurements of land classes

effected by various design alternatives for gravel pads and roads, airstrips and pipelines. Acquisition of multiple years of both physical and biological data greatly increases the reliability of the information.

Thank you.